Gravitation

Eg = mgh if g is uniform

H is relative to any arbitrary point

Eg = -GMm/r universally relative to 0 at r=infinity

Look at the graph of

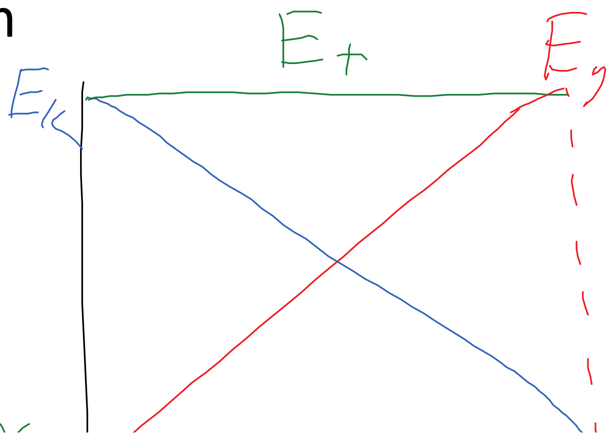
Eg, Ek and Et Et, is total energy Eg+Ek on y axis vs h or r on the x axis for :

1. A projectile shot up to 100m from Mars' surface
2. A projectile shot with enough kinetic energy to escape Mars' gravitational field - to infinity
   (escape speed)
3. A projectile with half escape kinetic energy
4. A projectile with double the escape energy
5. The set of objects in uniform circular motion orbiting mars at various r

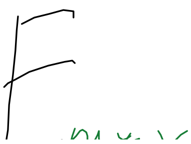
Set a scale for each of the graphs using a 500 kg rocket at surface of Mars

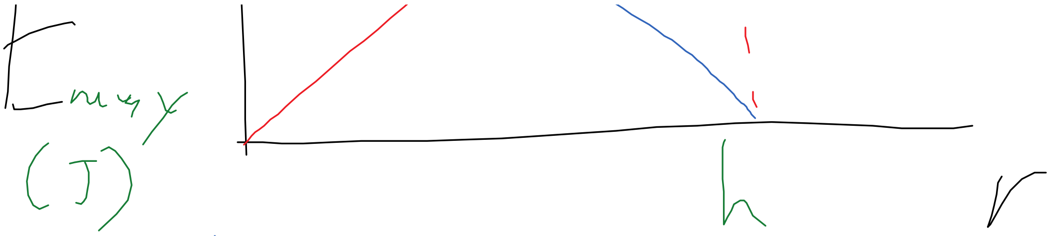
$M=6.42 \times 10^{23}$kg

R = 3 390 km

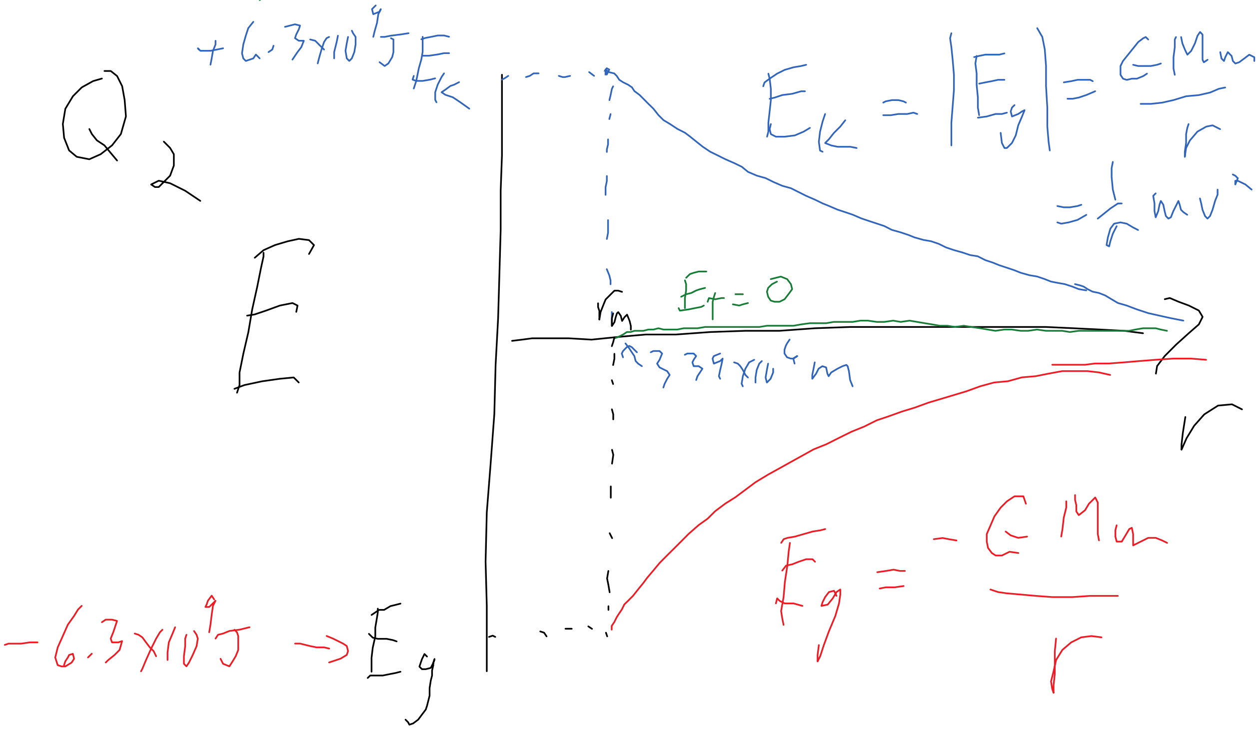


Q1





Q2



$$E_K = |E_g| = \frac{GMm}{r} = \frac{1}{2}mv^2$$

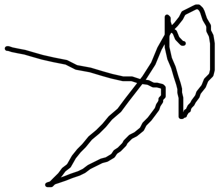
$$E_g = -\frac{GMm}{r}$$

at escape speed

$$\frac{1}{2}\cancel{m}v^2 = \frac{GM\cancel{m}}{r}$$

$$v_{escape} = \sqrt{\frac{2GM}{r}}$$

$$E_g = -\frac{(6.67\times10^{-11}\,\frac{Nm^2}{kg^2})(6.42\times10^{23}\,kg)(500\,kg)}{3\,390\,000\,m}$$

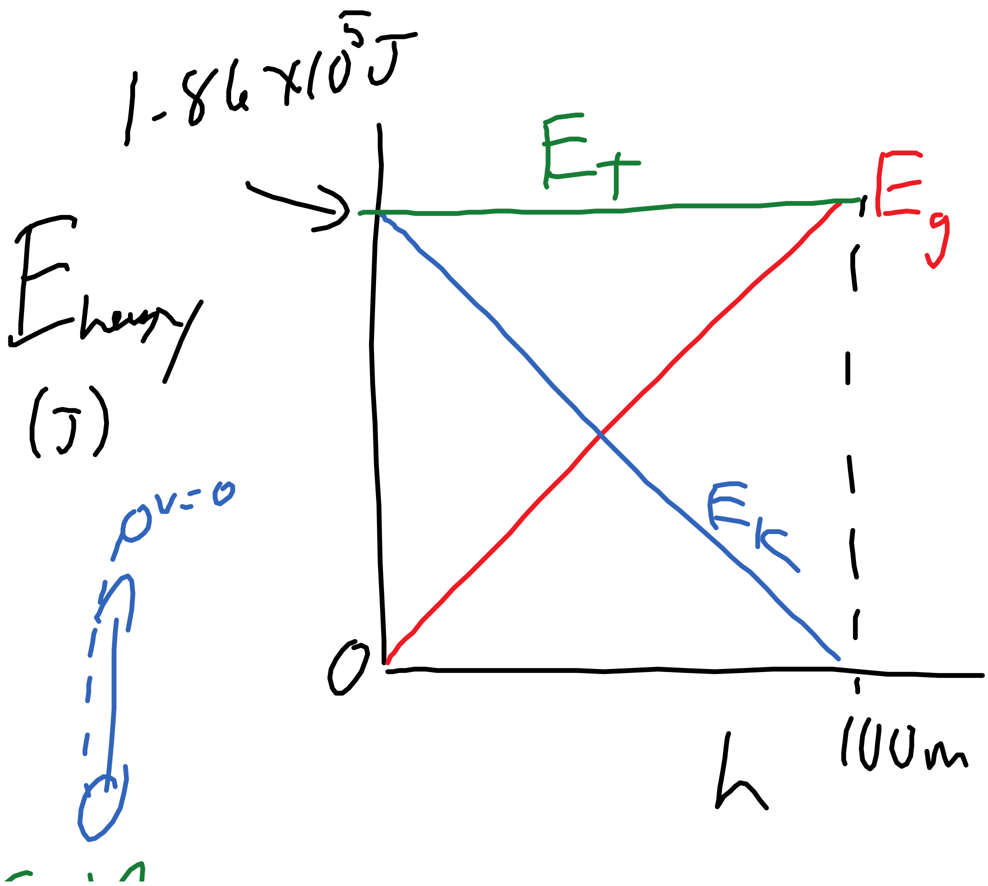


5 540 000 m

* Km → m

$$= \boxed{6.32 \times 10^{9}\,J}$$

Q1



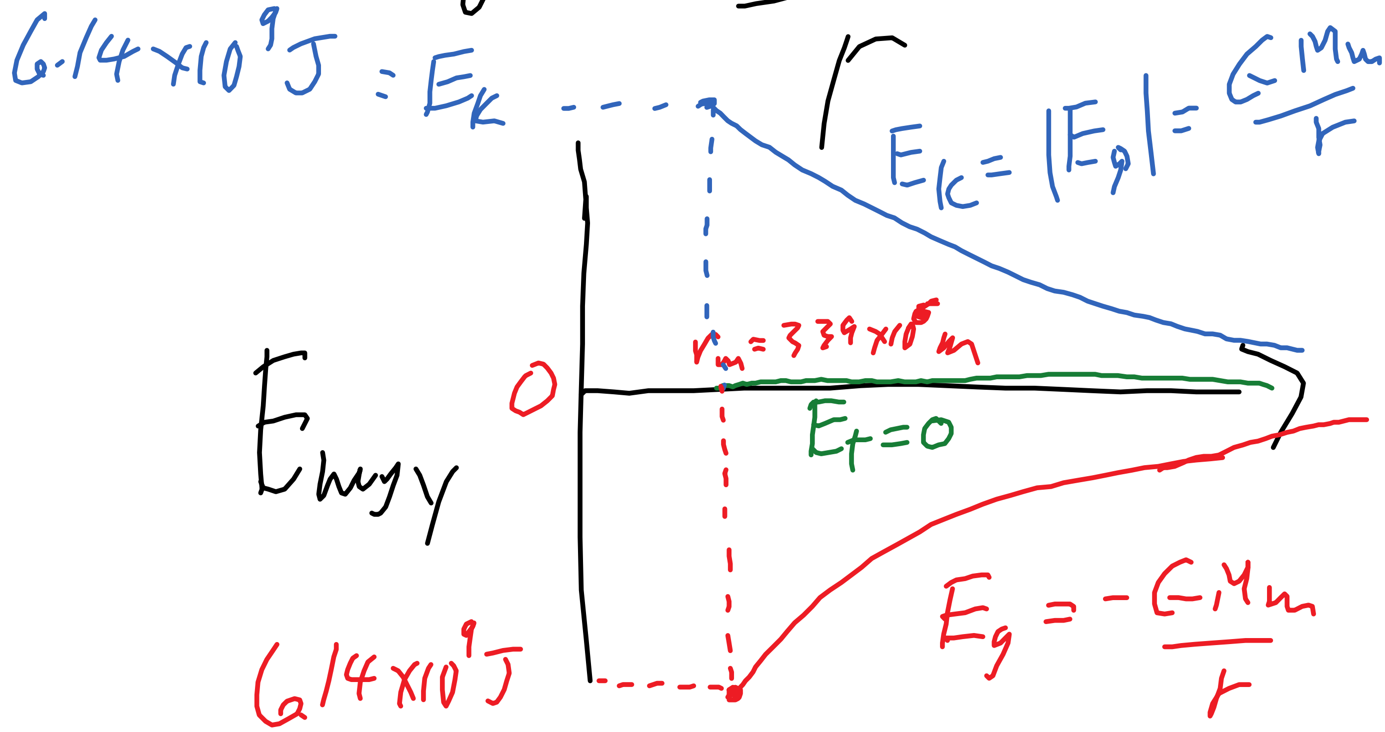
$E_g = mgh$

F_g ...

0 — h — 100m

$g = GM$

Q2 $E_g = -\dfrac{GMm}{r}$



$$g = \frac{6.67\times10^{-11}\frac{Nm^2}{kg^2}\left(6.42\times10^{23}\,kg\right)}{(3\,390\,000)^2}$$

Km → m

$g = 3.73\ N/kg$

Q1 $mgh = 500kg\left(3.73\frac{N}{kg}\right)100m$

$= \boxed{1\ 86 \times 10^5 J}$

Q2 $E_g = -\frac{6.67\times10^{-11}(6.24\times10^{23})(500)}{3390\ 000}$

$= \boxed{-6.14 \times 10^9 J}$